

Experimental Error Analysis

--excerpted from Chapter 9, Terms, Tables & Skills for the Physical Sciences by Bobby J. Woodruff, ©1966.

Classes of Errors:

1. **Systematic Errors**- in which the fault often lies with the imperfections of equipment.

1A. Errors Due To Experimental Conditions- The particular method used in an experiment or the conditions under which it is conducted may introduce systematic errors.

1B. Method Error (Human Errors) - It is said, "To err is human," but erring should not be systematic if it can be avoided, and it usually can. Some human errors are easily correctable and as such are inexcusable. Carelessly reading an instrument without taking account of *parallax*¹ is an error that can certainly be reduced. With care and diligence, errors caused by the misreading of scales can be reduced. The reflex delay in timing and the difficulty in sighting simultaneous events are examples of the limitations of our senses that are a source of systematic error about which little can be done except to try to account for them in our Interpretation of data.

1C. Instrumental Errors- All instruments have their limitations. Some of these limitations may result from shoddy construction, faulty calibration, slight friction among the moving parts of the instrument, or other factors, Errors may be introduced by the very nature of the measuring instrument itself.

1D. Errors Due to the Nature of the Quantity Measured- Sometimes the very act of measuring noticeably alters the object being measured. One might attempt to determine the average diameter of a snowflake, but under ordinary conditions, the process of measurement alters the nature of the snowflake.

2. **Random Errors**- in which the fault often lies with the imperfect observation and technique

2A. Errors Due To Experimental Conditions- During the progress of an investigation, there might be fluctuations in temperature, humidity, atmospheric pressure, or changes in the potential difference of a circuit. Friction might result in random, rather than systematic, errors.

2B. Method Error (Human Errors)- In judging the position of a jittery needle, a person may over judge the true value in some cases and under judge it in other cases. The chances are that he/she will do an equal amount of each. A person is subject to making random errors when he attempts to read the milliliter markings on a 100 mL graduated cylinder.

2C. Instrumental Errors- No matter how well designed and calibrated an instrument is, there is still a limit of reliability associated with the use of the instrument. We still cannot use an instrument to measure a quantity to an infinite number of significant figures. An instrument usually may be considered reliable to its smallest marked graduation. Remember, the last figure is recorded as a significant one, even though it is doubtful.

2D. Errors Due to the Nature of the Quantity Measured- The quantity being measured may cause errors of a random nature.

Experimental Analysis of Errors:

1. List and identify 3 or more sources of error.
2. Classify each as to what kind of error it is.
3. Explain how each source of error affected your experiment.
4. List possible solution(s) to your errors.

¹**Parallax** is the apparent change in the position of objects due to a change in the position of the observer.
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